

IMPROVEMENT ON FAN GUARD STRUCTURE FOR
ADDITIONAL SUPERCHARGING FUNCTION

FIELD OF THE INVENTION

5 The present invention is related to a fan guard structure, and more particular to an improved fan guard structure which imparts a supercharging function to a fan for efficient heat dissipation.

BACKGROUND OF THE INVENTION

10 Currently, heat-dissipating fans commonly used in personal computers include an axial-flow fan, a centrifugal fan and a cross-flow fan. Of these, the most popular one is supposed to be an axial-flow fan.

A fan is primarily consisted of a rotor device and a fan guard arranged beside the rotor device for supporting the rotor device.
15 Referring to Fig. 1, the fan guard 10 of a conventional axial-flow fan is constructed by a main frame 101, a motor holder 102 and a plurality of ribs 103 arranged between the main frame 101 and the motor holder 102. The rotor device 11 includes a motor (not shown) received in the motor holder 102, a shaft ring 111 connected to and driven by the motor to
20 revolve, and a plurality of rotor blades 112 fixed on the circumferential surface of the shaft ring 111 and revolving with the shaft ring 111 to work on the surrounding air to generate an airflow. Through the work of the rotor blades on the surrounding air, the blast pressure is changed from a relatively low value on the air inlet side into a relatively high
25 value on the air outlet side. That is, there is a blast pressure enhancement on the air outlet side.

Unfortunately, when the airflow further flows through the fan guard

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having the structure as shown in Fig. 1 and as described above, turbulent flows will be generated after the airflow encounters the ribs so as to have an adverse effect on the blast pressure enhancement. Consequently, the efficiency of the fan is reduced.

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SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide an improved fan guard structure which has a function of supercharging a fan in addition to supporting a rotor device.

10 The present invention is related to a fan guard to be mounted beside a rotor device of a fan for supporting the rotor device. Additionally, the fan guard according to the present invention interacts with an airflow generated by the revolution of the rotor blades to supercharge the fan.

The fan guard essentially includes a main frame, and a set of guard
15 blades radially arranged inside the main frame and fixed onto an inner surface of the main frame by each one end thereof. Generally but not definitely, a count of the guard blades is about 1~2 times of that of the rotor blades. Preferably, the other ends of the guard blades are fixed onto a cylindrical motor holder which is located at the center of the main
20 frame, and is hollow for receiving therein a motor used for driving the rotor blades to revolve. Especially preferred, at least one reinforcing ring connecting all of the guard blades is provided for strengthening the fan guard. In general, the guard blades are made of plastic. Nevertheless, the guard blades can also be made of a material other than plastic for a
25 desired purpose. For example, they can be made of a metal which is advantageous for heat dissipation.

To assemble the fan, the main frame of the fan guard is coupled to

the frame of the rotor device. Alternatively, the main frame of the fan guard is integrally formed with the frame of the rotor device so that the fan can be assembled by installing the non-integrally formed parts into the common frame. The fan guard can be arranged either upstream or downstream of the rotor device. Preferably, the fan guard includes two sets of frame and guard blades respectively arranged by both sides of the rotor device. By properly designing the shapes and the position arrangement of the guard blades relative to the rotor blades, the upstream guard blades can guide air into the rotor device at an angle to make an air inflow to the rotor device have an additional tangential velocity which increases the work of the rotor blades on air, and on the other hand, the downstream guard blades can transform a tangential velocity of an air outflow from the rotor device into a static pressure, both advantageous for supercharging the fan. For example, all of the guard blades are made to have a shape identical to the shape of the rotor blades. As for the position arrangement of the downstream guard blades relative to the upstream rotor blades, one of the guard blades and one of the rotor blades constitute a near letter C configuration in a cross-sectional view instantaneously. Contrarily, the position arrangement of the upstream guard blades relative to the downstream rotor blades makes one of the guard blades and one of the rotor blades constitute a near letter S configuration in a cross-sectional view instantaneously.

Furthermore, by taking the combination of a fan guard according to the present invention and a rotor device as a fan unit, a fan can be designed to include a plurality of such fan units to enhance efficiency.

BRIEF DESCRIPTION OF THE DRAWING

The present invention will now be described more specifically with reference to the following embodiments. It is to be noted that the following descriptions of preferred embodiments of this invention are presented herein for purpose of illustration and description only; it is not intended to be exhaustive or to be limited to the precise form disclosed. On the other hand, all arrows shown in the drawings are used for schematically illustrating the directions of airflows and velocities, and the length of the arrows does not indicate the measure of the corresponding items.

Please refer to Fig. 2A which schematically shows a rotor device and a preferred embodiment of a fan guard according to the present invention. The rotor device 21, as conventionally used, includes a motor 211, a shaft ring 212 connected to the motor 211, and a plurality of rotor blades 213 fixed on the circumferential surface of the shaft ring 212. The fan guard 20 includes a main frame 201, a motor holder 202, and a plurality of guard blades 203. The motor holder 202 is a hollow cylinder located at the center inside the frame for receiving therein the motor 211. The guard blades 203 are radially disposed within the main frame 201. One end 2031 of each of the guard blades 203 is fixed onto the inner surface 2011 of the main frame 201 and the other end 2032 thereof is fixed onto the circumferential surface 2021 of the motor holder 202. In this embodiment, the frames of the fan guard and the rotor device are integrally formed as the main frame 201. In other words, the motor 211, shaft ring 212, rotor blades 213, motor holder 202, and guard blades 203 are all positioned inside the main frame 201.

The assembled fan is shown on Fig. 2B. In this embodiment, the rotor blades are located upstream of the guard blades. When the fan

operates, the motor 211 (see Fig. 2A) drives the shaft ring 212 with the rotor blades 213 to revolve. The revolution of the rotor blades 213 results in work on the surrounding air to generate an airflow. The arrows F_i and F_o in the figure indicates the air inflow and the air outflow, respectively. Through the work of the rotor blades on the surrounding air, the blast pressure is changed from a relatively low value on the air inlet (F_i) side into a relatively high value on the air outlet (F_m , Fig. 3) side. That is, there is a blast pressure enhancement on the air outlet (F_m) side. According to the present invention, the blast pressure can be further increased on the air outflow (F_o) side through the guard blades of the fan guard for the reason described as follows.

Please refer to Fig. 3. In order to concretely illustrate the arrangement of the guard blades, an upstream rotor blade 313 which can be any one of the rotor blades and a downstream guard blade 303 which can be any one of the guard blades, are shown in a cross-sectional view, and a specific moment that a leading point A of the ~~rotor~~^{guard} blade ~~313~~³⁰³ is moved to be axially aligned with the trailing point B of the ~~guard~~^{rotor} blade ~~303~~³¹³ is taken to facilitate to describe the position relationship between the selected rotor blade and guard blade. As shown, the rotor and the guard blades 313 and 303 constitute a near letter C configuration.

When the rotor device operates to have the rotor blade 313 revolve at a tangential velocity V_r , the airflow arriving at the guard blade 303 has an axial velocity and a tangential velocity. Due to conservation of mass, the axial velocity will not change through the entire guard blade 303, and is represented by a reference symbol V_a in Fig. 3. The tangential velocity, however, varies from a relatively high value V_t approximating the velocity V_r of the rotor blade to a relatively low value

Vt' down to zero. According to the Bernoulli's Law, the pressure will increase with the decrease of velocity. The tangential velocity of the airflow F_m will be transformed into a static pressure. Accordingly, the blast pressure further rises through the fan guard, and the fan is thus
5 supercharged.

Although such a near C configuration is exemplified as above to describe a preferred embodiment, other configurations are acceptable as long as the purpose of transforming a tangential velocity into a static pressure can be achieved.

10 In another embodiment according to the present invention, the guard blades are arranged upstream of the rotor blades. As shown in Fig. 4, the position relationship between an upstream guard blade 403 and a downstream rotor blade 413 is illustrated at a moment that a leading
A point C of the ~~guard~~^{rotor} blade 403 is moved to follow the camber line CL of the guard blade 403. The guard and rotor blades 403 and 413 at such
15 moment constitute a near letter S configuration.

When the rotor device operates to have the rotor blade 413 revolve at a tangential velocity V_r , the guard blade 403 guide air into the rotor blade 413 at an angle. Consequently, the air outflow from the guard
20 blade 403 has an axial velocity V_a and a tangential velocity V_t , and thus the airflow arriving at the rotor blade 413 has a tangential velocity of $V_r + V_t$. As known, the increase of the tangential velocity enhances the work of the rotor blades on air, so in this way, the fan is supercharged.

Although such a near S configuration is exemplified as above to
25 describe a preferred embodiment, other configurations are acceptable as long as the purpose of providing an additional tangential velocity can be achieved.

Please now refer to Figs. 5~8 which schematically show several composite fans which include a plurality of fan guards according to the present invention and/or rotor devices to further enhance fan efficiency.

The composite fan shown in Figs. 5A and 5B is assembled by
5 screwing the frames 511, 521 of the rotor devices 51, 52 and the frame 501 of the fan guard 50 together (Fig. 5A) so that the guard blades 503 can be upstream of the rotor blades 523 and downstream of the rotor blades 513 (Fig. 5B) to simultaneously enhance the efficiencies of the upstream rotor device 51 and downstream rotor device 523 so as to
10 supercharge the composite fan.

Fig. 6 schematically shows another embodiment of composite fan according to the present invention. In this embodiment, there are a set of
A guard ~~fans~~^{blades} 603 located upstream of rotor blades 613 and another set of
A guard ~~fans~~^{blades} 623 located downstream of the rotor blades 613 to both
15 enhance the efficiency of the rotor device. By this way, the composite fan is supercharged.

A further embodiment of a composite fan is shown on Fig. 7 wherein two fan units, each consisting of a fan guard 70 according to the present invention and a rotor device 71, are directly coupled to form the
20 composite fan.

On the basis of the above fan guard skeletons, at least one reinforcing ring connecting the guard blades are preferably arranged for strengthening the fan guard. Referring to Fig. 8, the fan guard 80 includes two reinforcing rings 814.

25 Although the guard blades in the above embodiments are exemplified to have a shape identical to the shape of the rotor blades, they can be plane plates or any other suitable shapes as long as the

efficiency of the fan can be enhanced thereby.

The number of the guard blades need not be particularly limited, but one to two times of the count of the rotor blades will result in satisfactory performance.

5 The guard blades can be made of plastic. Nevertheless, the guard blades can also be made of a material other than plastic for a desired purpose. For example, when they are made of metal, the guard blades can serve as efficient heat-dissipating plates to further enhance the heat-dissipating efficiency.

10 To sum up, according to the present invention, the performance of a fan can be easily improved by changing the structure of the fan guard conventionally only used for supporting the fan. On the other hand, it is even advantageous because for the application to compact products, the high performance of the fan according to the present invention allows
15 the fan size to be reduced so as to be installed properly.

While the invention has been described in terms of what are presently considered to be the most practical and preferred embodiments, it is to be understood that the invention need not be limited to the disclosed embodiment. On the contrary, it is intended to cover various
20 modifications and similar arrangements included within the spirit and scope of the appended claims which are to be accorded with the broadest interpretation so as to encompass all such modifications and similar structures.